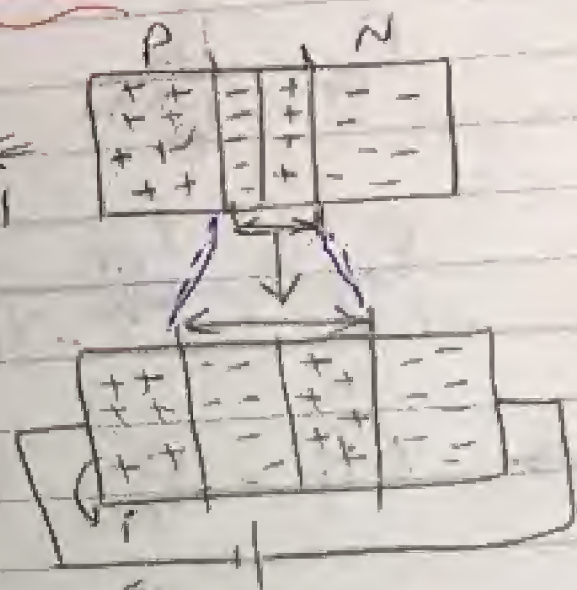
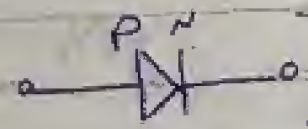


* PN Junction under Reverse Bias *

في حالة ال Reverse يتجاذب مع
الايون مع سالبة الكارriers
ويتجاذب سالبة الايون مع موجبة الكارriers
فتزداد مساحة ال Depletion Region
فتبدو وكأنها open-circuit دائرة مفتوحة
تتدفق مرور التيار ويكاد ينعدم

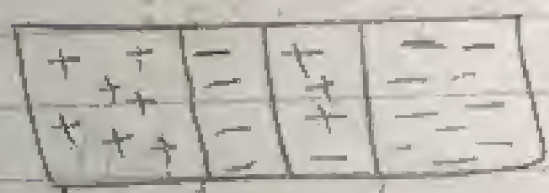


$$\Rightarrow G = \frac{C}{\sqrt{1 + \frac{V_R}{V_0}}}$$



* Forward Bias *

في حالة ال Forward
لحقت تناقصت P-type و الكارriers
ال سالبة n-type
فتنكمش مساحة ال Depletion Region
فتبدو وكأنها s.c دائرة قصر



$$V_0 = \frac{kT}{q} \ln \frac{P_p}{P_n} \Rightarrow \text{at (P-side)}$$

$$\Rightarrow \therefore \frac{kT}{q} = V_T \rightarrow \text{thermal}$$

$$V_0 = V_T \ln \frac{P_p}{P_n} \quad \therefore \frac{V_0}{V_T} = \ln \frac{P_p}{P_n}$$

$\therefore \frac{v_o/v_T}{e} = \frac{P_p}{P_n} \rightarrow \therefore P_n = \frac{P_p}{e^{v_o/v_T}}$ at equilibrium
في حالة التوازن

reverse $P_{ne} = \frac{P_{pe}}{e^{v_o/v_T}} \rightarrow (1)$

forward $P_{nf} = \frac{P_{pf}}{(e^{v_o/v_T} - 1)} \rightarrow (2)$

$\Rightarrow \Delta P_n = P_{nf} - P_{ne} = \left[\frac{P_{pf}}{(e^{v_o/v_T} - 1)} - \frac{P_{pe}}{e^{v_o/v_T}} \right]$

$\therefore \Delta P_n = \frac{N_A}{e^{v_o/v_T}} (e^{v_f/v_T} - 1) \rightarrow *$

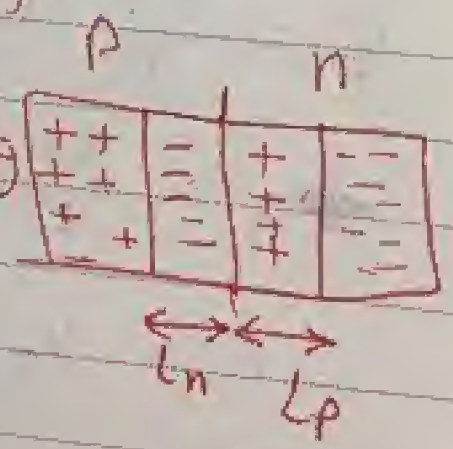
\Rightarrow Assume: $P_{pe} = P_{pf} = N_A$

$\therefore \Delta n_p = \frac{N_D}{e^{v_o/v_T}} (e^{v_f/v_T} - 1) \rightarrow **$

$\therefore I_{Tot} \propto (\Delta P_n + \Delta n_p) \therefore I \propto \frac{N_A}{e^{v_o/v_T}} (e^{v_f/v_T} - 1) + \frac{N_D}{e^{v_o/v_T}} (e^{v_f/v_T} - 1)$

$\therefore I_s = A q n_i^2 \left[\frac{D_n}{N_A L_n} + \frac{D_p}{N_D L_p} \right]$
 $\therefore I_f = I_s (e^{v_f/v_T} - 1)$
 (P-type) (n-type)

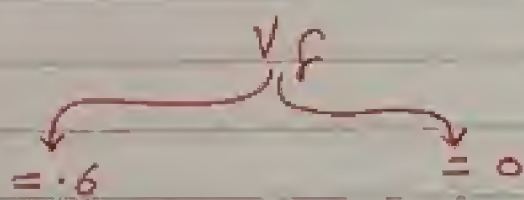
$\rightarrow L_p$ is the diffusion of p-type in n-type
 $\rightarrow L_n$ " " " of n-type in p-type



* $I_T = I_S (e^{V_F/V_T} - 1)$

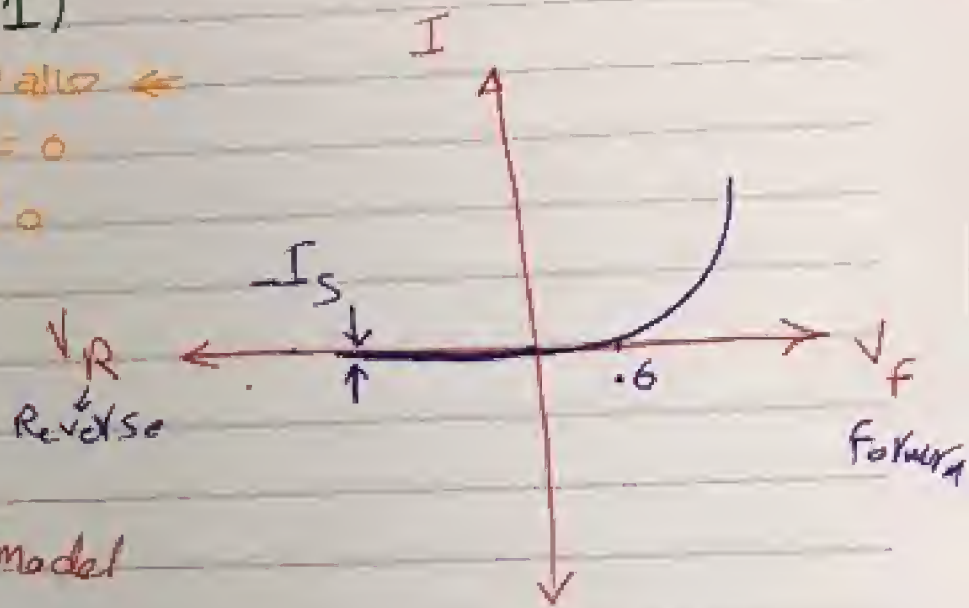
→ at $V_F = 0 \Rightarrow I = 0$

→ at $V_F = 0.6 \Rightarrow I = 0$



Constant model.

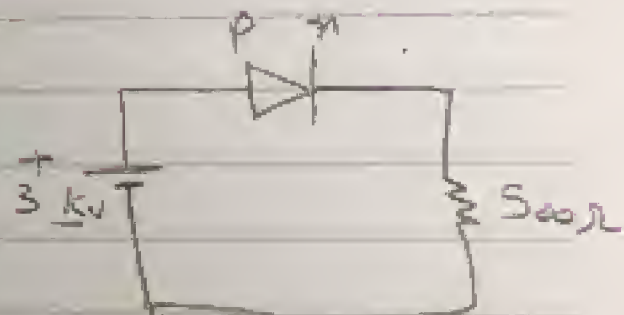
ideal model



ex:-

∴ connected with P-type

∴ P-N junction under Forward bias



$\Rightarrow E = V_D + I_D \cdot R$

at $V_D = 0$

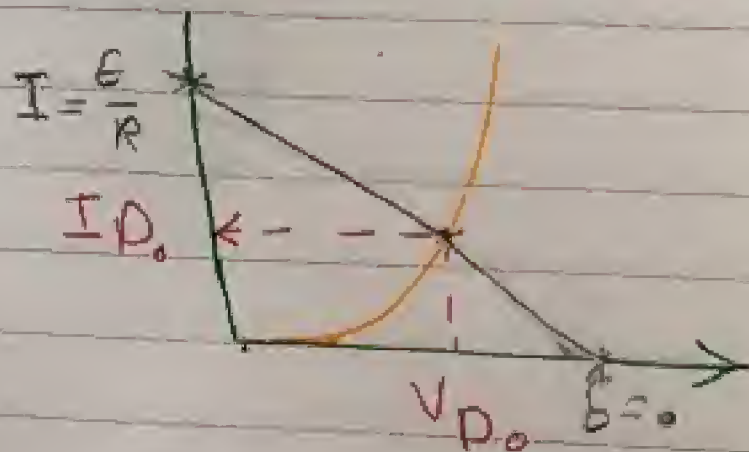
$\therefore E = I_D \cdot R \quad \therefore I_D = \frac{3 \times 10^3}{500}$

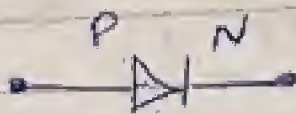
\Rightarrow at $I_D = 0$

$E = V_D$

$\Rightarrow \frac{V_{D0}}{I_{D0}} = R_{D0}$ "static Resistance"

at V_{D0} & I_{D0}





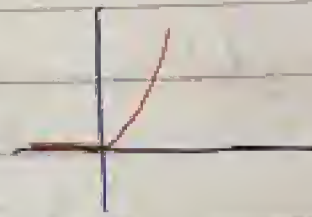
① Ideal.

② Constant Voltage

③ Exponential

① $\Rightarrow I_D = I_S (e^{V_D/KT} - 1)$

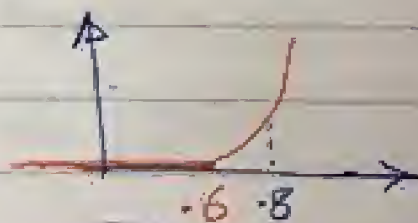
$I_D = I_S (\exp \frac{V_D}{KT} - 1)$



② $I_D = I_S (e^{V_D/KT} - 1)$



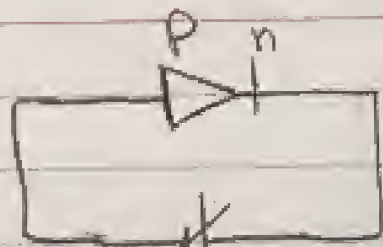
③ Exponential



$$I_S = A q n_i^2 \left(\frac{D_n}{N_A L_n} + \frac{D_p}{N_D L_p} \right)$$

As I_S is very small

Zener Breakdown :-



V_D يزيده
Doping اقل

Reverse B.A

الحجم العكسي يزيده

الطيف عياره عند دايود ال Doping يتاخر بنسبة

معدلة الهمسة ... تثبيت الفولت

وزيادة حصة التيار

لا فرق في الحجم العكسي يزيده حد كسب ال اكترونان - طاقة مركة كبيرة

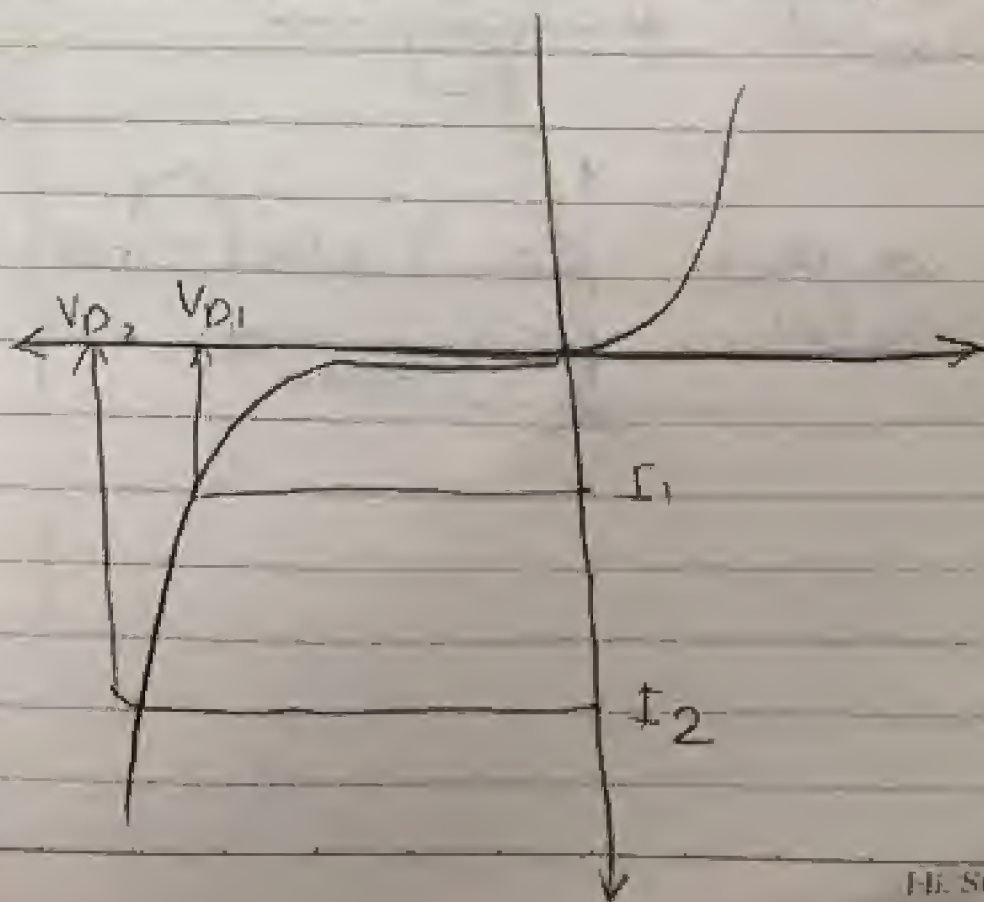
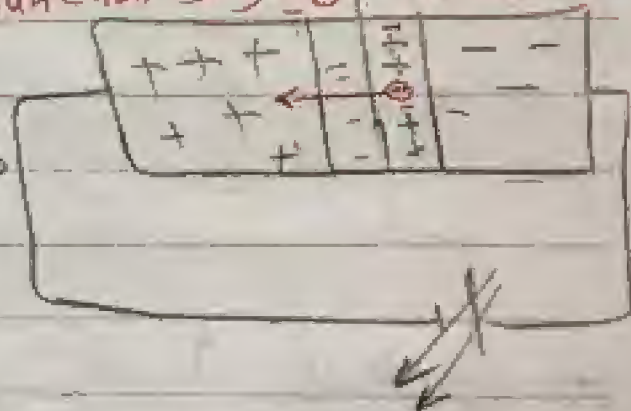
فتتبا ذن مع فحوان P-type ... فيحدث انهيار ال Junction

Breakdown انهيار ال Junction . وسع هذا

AVALANCH RD

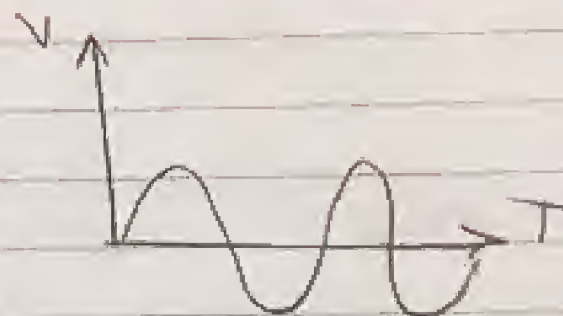
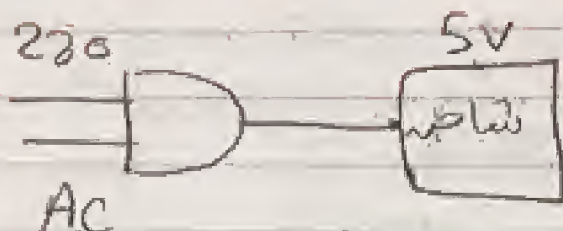
وهذا يحدث عند Doping اقل

و فرق جهد عاليه

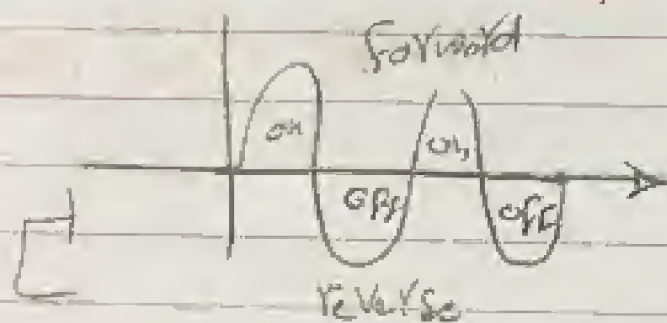


CH 2 :-

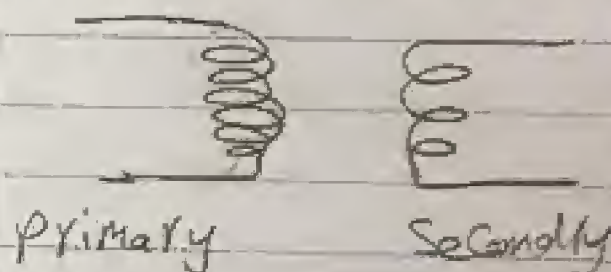
Diode Models and Application



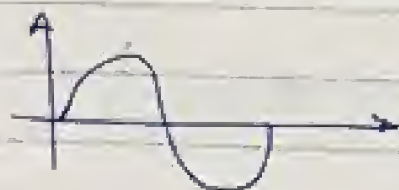
Diode as a switch
 → on (مفتوح)
 → off (مغلق)



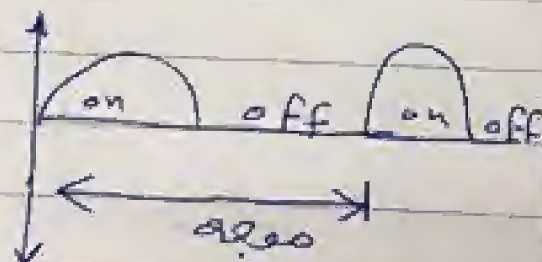
called
 * Step down transformer

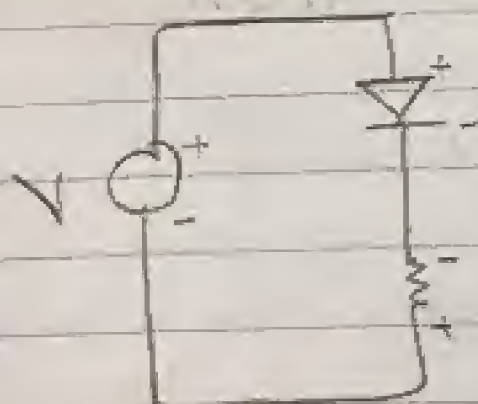
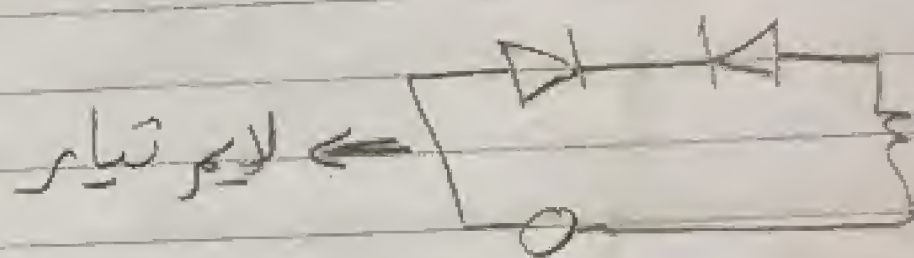
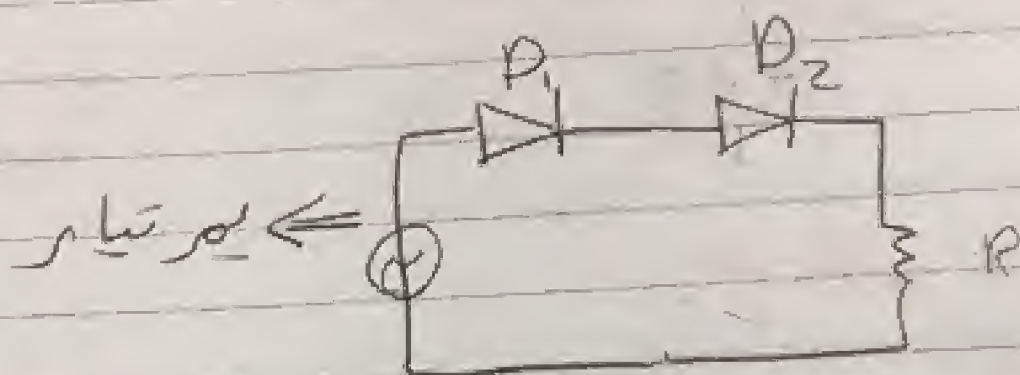
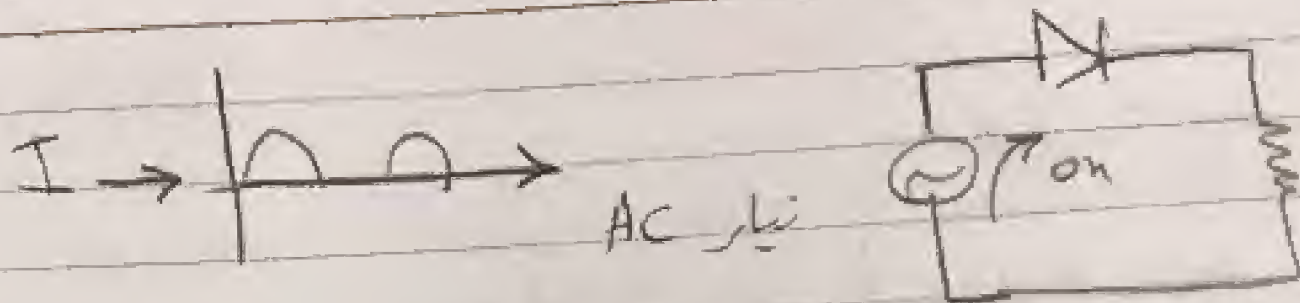


* الدقة قبل
 الدايود

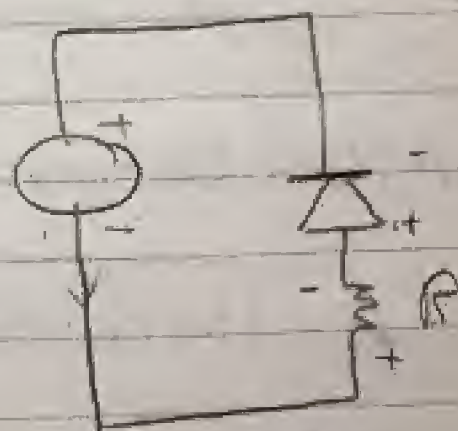


* الدقة بعد
 الدايود



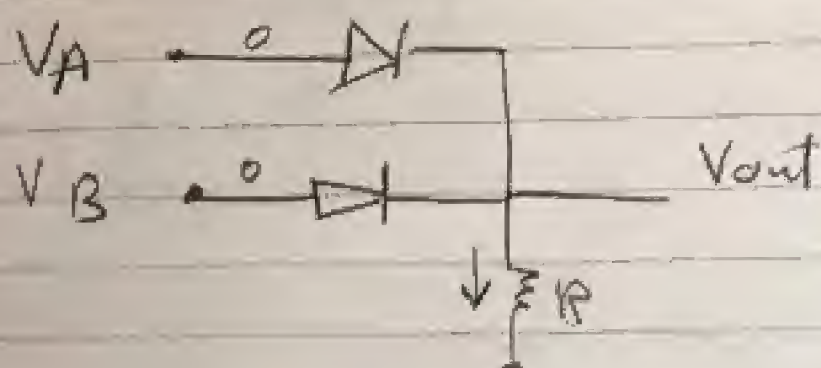


Forward



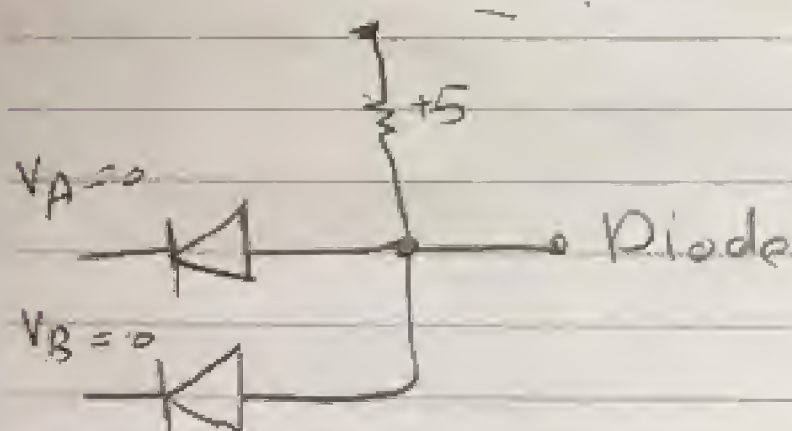
Reverse

التيار العكسي \leftarrow Reverse



V_A	V_B	V_{out}
0	0	0
0	1	1
1	0	1
1	1	1

OR Circuit



V_A	V_B	V_{out}
0	0	0
0	1	0
1	0	0
1	1	1

AND Circuit

Application of Diode:

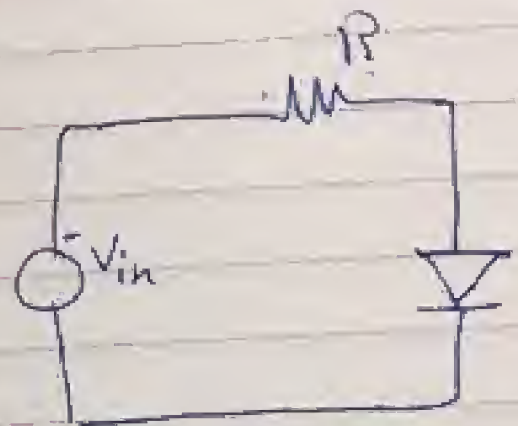
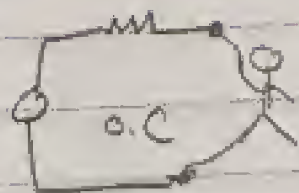
(i) Half wave Rectifier

* Diode \Rightarrow OR, AND

Resistor Diode Circuits

at $V_{in} < 0$ Diode forward
open circuit

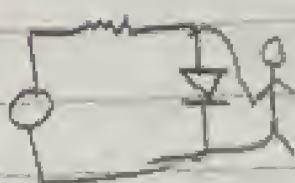
$$V_{in} = V_{out}$$



at $V_{in} > 0$

ideal ① $V_D = 0$

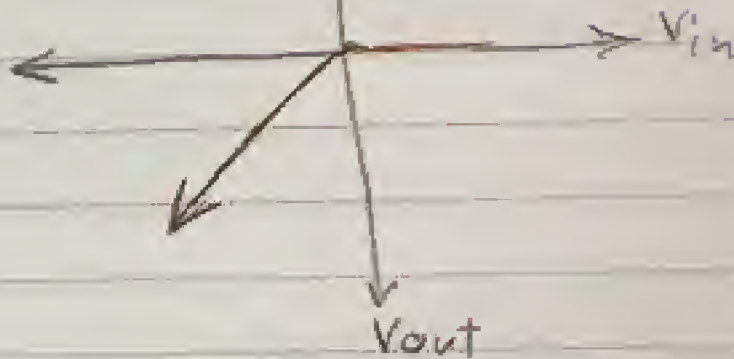
② $V_D = -6$



① \Rightarrow Diode forward on

$$\therefore V_D = 0 = V_o$$

V_{in}



② $V_D = -6$

